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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE: DISC BRAKE

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DISC BRAKE

FIELD OF THE INVENTION

[0001] The present invention relates to a disc brake used in the braking of a vehicle such as an automobile.

DESCRIPTION OF THE RELATED ART

[0002] An example of a disc brake installed in an automobile or the like is a caliper floating-type disc brake in which brake pads disposed on either side of a disc rotor which rotates together with the wheels are supported by a carrier which is fixed on the vehicle body side, and a caliper comprising a cylinder portion which is installed with a piston opposing one of the brake pads and a claw portion opposing the brake pad on the opposite side across the disc rotor is floatably supported by the carrier.

[0003] In a caliper floating-type disc brake, one of the brake pads is pushed directly against the disc rotor by the forward motion of the piston, whereupon the caliper is caused to move in reaction thereto such that the other brake pad is pushed against the disc rotor via the claw portion. As a result, a braking force is generated. At this time, the brake pads which are dragged against the disc rotor abut against the torque receiving face of the carrier and thus receive braking torque.

[0004] However, problems have arisen in such caliper floating-type disc brakes in that if the brake pads do not return sufficiently during braking release, drag occurs, and the resultant increase in running resistance causes a deterioration in fuel economy. Furthermore, brake judder occurs when the brake pads become partially worn. Another problem arises at the beginning of braking in that when the brake pads are dragged against the disc rotor and impinge on the torque receiving face of the carrier, a so-called "clonk" sound is produced.

[0005] To solve these problems, as described in Japanese Unexamined Patent Application 2002-327780, for example, a return spring is conventionally attached to the brake pads. The resultant spring force separates the brake pads from the

disc rotor and presses the brake pads against the torque receiving face of the carrier at all times, thereby preventing insufficient return of the brake pads and the generation of the clonk sound.

[0006] However, in this conventional caliper floating-type disc brake provided with a return spring, a worker may touch the return spring unintentionally during installation in a vehicle, washing of the vehicle, and so on, possibly causing deformation or displacement of the return spring.

SUMMARY OF THE INVENTION

[0007] The present invention has been designed in consideration of the above points, and it is an object thereof to provide a disc brake in which deformation and displacement of a return spring on the brake pads can be prevented.

[0008] In order to solve the problems described above, the present invention is a disc brake comprising a pair of brake pads disposed on either side of a disc rotor and pressed against the disc rotor by a piston, a supporting member attached on the vehicle body side which supports the pair of brake pads movably in the axial direction of the disc rotor, and a return spring having a base end portion attached to the brake pads and a distal end portion which presses the supporting member such that the brake pads are urged in a direction away from the disc rotor, wherein positioning means may be provided on the supporting member side in order to restrict the sideward movement of the distal end portion of the return spring.

[0009] According to such a constitution, displacement and deformation of the return spring are prevented by the positioning means.

[0010] Further, the present invention is a disc brake comprising a pair of brake pads disposed on either side of a disc rotor and pressed against the disc rotor by a piston, a supporting member attached on the vehicle body side which supports the pair of brake pads movably in the axial direction of the disc rotor, and a return spring having a base end portion attached to the brake pads and a distal end portion which presses the supporting member such that the brake pads are urged in a direction away from the disc rotor, wherein a protective convex portion having a protruding height of at least half the protruding height of the return spring may be

provided in a standing position in the vicinity of the return spring of the supporting portion.

[0011] According to such a constitution, the return spring is protected from being unintentionally touched during work or the like by the protective convex portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Fig. 1 is a side view of a disc brake according to a first embodiment of the present invention;

[0013] Fig. 2 is a plan view of the apparatus shown in Fig. 1;

[0014] Fig. 3 is a front view of the apparatus shown in Fig. 1;

[0015] Fig. 4 is a side view of the main parts of a disc brake according to a second embodiment of the present invention;

[0016] Fig. 5 is an enlarged front view of the main parts of a disc brake according to a third embodiment of the present invention; and

[0017] Fig. 6 is an enlarged front view of the main parts of a disc brake according to a fourth embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] Embodiments of the present invention will be described in detail below on the basis of the drawings.

[0019] A first embodiment of the present invention will be described with reference to Figs. 1 through 3. As shown in Figs. 1 through 3, a disc brake 1 of this embodiment is a caliper floating-type disc brake comprising a disc rotor D which rotates together with the vehicle wheel, a carrier 2 (supporting member) fixed on the vehicle body side, a caliper 3 which is floatably supported on the carrier 2, and a pair of brake pads 4, 5 which are disposed on either side of the disc rotor D and supported by the carrier 2.

[0020] The carrier 2 supports the pair of brake pads 4, 5 by means of respective support portions 6, 7 disposed across and on either side of the disc rotor D. An attachment portion 8 formed on the support portion 6 which is disposed further

toward the inside of the vehicle body than the disc rotor D is typically fixed by bolts or the like to a member on the vehicle body side such as a knuckle. Inward-facing torque receiving faces 6A, 6B and 7A, 7B are formed respectively on the support portions 6, 7 at the two ends thereof in the rotational direction of the disc rotor D, which is illustrated by an arrow in the drawing, and rectangular guiding grooves 6C, 6D and 7C, 7D (the guiding grooves 6C, 6D are not shown in the drawing) extending in the axial direction of the disc rotor D are formed respectively on the torque receiving faces 6A, 6B and 7A, 7B.

[0021] The brake pads 4, 5 are constituted by friction members 4A, 5A that are pushed against the disc rotor D and rear plates 4B, 5B which are tightly fixed to and thereby support the friction members 4A, 5A. Rectangular ear portions 4C, 4D and 5C, 5D (the ear portions 4C, 4D are not shown in the drawings) protrude respectively from the two ends of the rear plates 4B, 5B. By inserting the rear plates 4B and 5B respectively between the inward-facing torque receiving faces 6A, 6B and 7A, 7B of the carrier 2 and fitting the ear portions 4C, 4D and 5C, 5D into the guiding grooves 6C, 6D and 7C, 7D, the brake pads 4, 5 are slidably supported along the axial direction of the disc rotor D by the carrier 2.

[0022] One pad spring 9 (guiding member) attached on the carrier 2 side is interposed between the torque receiving faces 6A, 7A and guiding grooves 6C, 7C of the carrier 2, and the ear portions 4C, 5C and one end of the rear plates 4B, 5B of the brake pads 4, 5. One more pad spring 10 attached on the carrier 2 side is interposed between the torque receiving faces 6B, 7B and guiding grooves 6D, 7D, and the ear portions 4D, 5D and the other end of the rear plates 4B, 5B. The pads springs 9, 10 enable the brake pads 4, 5 to move smoothly and protect the carrier 2. Shims 11, 12 (the shim 11 is not shown in the drawings) are attached to the rear face of the rear plates 4B, 5B of the brake pads 4, 5 to prevent brake noise.

[0023] A cylinder portion 13 installed with two pistons (not shown) opposing one of the brake pads 4 is provided in the caliper 3, and a claw portion 14 opposing the other brake pad 5 is formed on the other side of the disc rotor D. By respectively attaching sliding pins 17, 18 to arm portions 15, 16 formed on the two ends of the caliper 3 and slidably inserting these sliding pins 17, 18 into guiding

holes (not shown) provided in the two ends of the carrier 2, the caliper 3 is supported floatably and movably along the axial direction of the disk rotor D. Note that in the drawings, the reference numerals 19, 20 designate pin boots for protecting the sliding pins 17, 18.

[0024] Return springs 21, 22 are attached to the rear plates 4B, 5B of the brake pads 4, 5 at the respective front end portions thereof in the rotational direction of the disc rotor D. The return springs 21, 22 are caulked to protrusions 23, 24 (the protrusion 23 of the rear plate 4A is not shown in the drawings) protruding from the base portion of the ear portions 4C, 5C on the rear plates 4B, 5B so as to extend away from the disc rotor D and extend at an incline toward the bottom portion side of the guiding grooves 6C, 7C of the carrier 2. The distal end portions thereof are pressed against contact portions 25, 26 (one of the contact portions 25 is not shown in the drawings) of the pad spring 9 which extend along the surface of the support portions 6, 7 of the carrier 2. Due to the spring force of the return springs 21, 22, the brake pads 4, 5 are urged in a direction away from the disc rotor D at all times.

[0025] Note that the spring force of the return springs 21, 22 may also be used to press the brake pads 4, 5 against the torque receiving faces 6B, 7B to the rear of the rotation direction of the disc rotor D at all times by raising the distal end portions of the contact portions 25, 26 from the surface of the carrier 2 and pressing the distal end portions of the return springs 21, 22 against these raised portions.

[0026] A positioning convex portion 27 is provided in a standing position on the surface of the support portion 7 of the carrier 2, and adjacent to the outside of the contact portion 26 against which the distal end portion of the return spring 22 is pressed in the diametrical direction of the disc rotor D. A wall portion 27A of the positioning convex portion 27 which opposes the return spring 22 restricts sideward movement of the distal end portion of the return spring 22. The contact portion 26 of the pad spring 9 extends to the opposite side of the positioning convex portion 27, and due to this expanded portion 28, the distal end portion of

the return spring 22 is unlikely to separate from the contact portion 26 when moving to the opposite side from the positioning convex portion 27.

[0027] A protective convex portion 29 is provided in a standing position integrally with the surface of the support portion 7 of the carrier 2 in the vicinity of the return spring 22 (in the example in the drawings, to the inside of the return spring 22 in the diametrical direction of the disc rotor D). As shown in Fig. 3, the protruding height h of the protective convex portion 29 is set at approximately half the protruding height H of the return spring 22 to prevent interference with other components (not shown) such as the wheel, but is preferably set to at least half the protruding height H of the return spring 22 and may be set to the protruding height H or more.

[0028] Operations of this embodiment constituted as described above will now be described.

[0029] When brake fluid is supplied to the cylinder portion 13 from a master cylinder (not shown), the piston moves forward to push the brake pad 4 against the disc rotor D. In reaction thereto, the caliper 3 moves, whereby the claw portion 14 presses the brake pad 5 against the disc rotor D to generate a braking force. At this time, the brake pads 4, 5 which are dragged against the disc rotor D abut against the torque receiving faces 6B, 7B of the carrier 2 with the pad spring 10 interposed therebetween, and hence receive braking torque.

[0030] When the fluid pressure of the brake fluid from the master cylinder is released, the piston retreats, and the spring force of the return springs 21, 22 causes the brake pads 4, 5 to separate from the disc rotor D such that braking is released. By means of the spring force of the return springs 21, 22, the brake pads 4, 5 can be reliably separated from the disc rotor D, thereby preventing drag on the brakes, fuel economy deterioration, and brake judder.

[0031] Further, in cases where the brake pads 4, 5 are pressed against the torque receiving faces 6B, 7B to the rear of the rotation direction of the disc rotor D by the spring force of the return springs 21, 22 at all times, as described above, the clonk sound which is produced at the beginning of braking when the brake

pads 4, 5 drag against the disc rotor D and impinge on the torque receiving faces 6B, 7B can be prevented.

[0032] By standing the positioning convex portion 27 on the supporting portion 7 of the carrier 2 to restrict movement of the distal end portion of the return spring 22, and by providing the extended portion 28 on the contact portion 26 of the pad spring 9 against which the distal end portion of the return spring 22 is pressed, deformation and displacement of the return spring can be prevented even when a worker touches the return spring 22 unintentionally when attaching the disc brake 1 to a vehicle, washing the vehicle, and so on, and thus the function of the return spring 22 can be maintained.

[0033] In the embodiment described above, the positioning convex portion 27 is disposed on one side of the return spring 22, and the extended portion 28 of the contact portion 26 is formed on the opposite side. Note, however, that movement of the distal end portion of the return spring 22 may be restricted by providing another positioning convex portion on the opposite side instead of the extended portion 28.

[0034] Further, the protective convex portion 29 is provided in a standing position in the vicinity of the return spring 22 on the support portion 7 of the carrier 2, and hence when the disc brake 1 is placed on a flat surface with the claw portion 14 facing downward during installation of the disc brake 1 into a vehicle, the claw portion 14 and protective convex portion 29 contact the flat surface, but the return spring 22 does not contact the flat surface. Similarly, if a washing instrument or the like contacts the disc brake 1 during washing of the vehicle and so on, the claw portion 14 and protective convex portion 29 may contact the washing instrument or the like, but the return spring 22 is prevented from or becomes less likely to contact the washing instrument or the like. Thus the return spring 22 can be protected from unintentional contact or the like during installation of the disc brake 1 into a vehicle, washing of the vehicle, and so on, and hence deformation and displacement of the return spring 22 can be prevented. Note that the height h of the protective convex portion 29 is set at approximately half the protruding height H of the return spring 22 to avoid interference with

other components such as the wheel, but in order to obtain a sufficient protective effect, the height h is preferably set to at least half the protruding height H of the return spring 22, and may be set at the protruding height H of the return spring 22 or more.

[0035] Next, second to fourth embodiments of the present invention will be described with reference to Figs. 4 through 6. Note that in the following descriptions, identical reference numbers to those in the first embodiment have been allocated to identical parts, and only different parts will be described in detail.

[0036] As shown in Fig. 4, in a disc brake 30 according to a second embodiment of the present invention, in contrast to the first embodiment described above, the contact portion 26 of the pad spring 9 is omitted, and the distal end portion of the return spring 22 is caused to contact the surface of the support portion 7 of the carrier 2 directly. Further, a positioning convex portion 31 having an inverse "C" form is provided in a standing position on the surface of the support portion 7, and the distal end portion of the return spring 22 is inserted into a rectangular groove portion 32 of the positioning convex portion 31. Sideward movement of the distal end portion of the return spring 22 is restricted by a wall portion 32A on the inside of the groove portion 32.

[0037] Hence deformation and displacement of the return spring 22 can be prevented, and the same actions and effects as those of the first embodiment can be realized.

[0038] As shown in Fig. 5, in a disc brake 33 according to a third embodiment of the present invention, in contrast to the first embodiment described above, the extended portion 28 formed on the contact portion 26 of the pad spring 9 is omitted, and a rectangular concave portion 34 is formed on the surface of the support portion 7 of the carrier 2 instead of the positioning convex portion 27. The contact portion 26 of the pad spring 9 and the distal end portion of the return spring 22 are inserted into this concave portion 34, and sideward movement of the distal end portion of the return spring 22 is restricted by a wall portion 34A on the inside of the concave portion 34.

[0039] Hence deformation and displacement of the return spring 22 can be prevented, and the same actions and effects as those of the first embodiment can be realized.

[0040] As shown in Fig. 6, in a disc brake 35 according to a fourth embodiment of the present invention, in contrast to the first embodiment described above, the positioning convex portion 27 and the extended portion 28 of the pad spring 9 are omitted, and in place thereof, raised portions 36, 37 are formed across the two side portions of the contact portion 26 of the pad spring 9. Sideward movement of the distal end portion of the return spring 22 is restricted by wall portions 36A, 37A on the inside of the raised portions 36, 37.

[0041] Hence deformation and displacement of the return spring 22 can be prevented, and the same actions and effects as those of the first embodiment can be realized.

[0042] Further, by combining the first embodiment and fourth embodiment, movement of the distal end portion of the return spring 22 to one side may be restricted by the positioning convex portion 27 provided on the support portion 7 of the carrier 2, and movement of the distal end portion of the pad spring 9 to the other side may be restricted by the raised portion 37 provided on the contact portion 26 of the pad spring 9.

[0043] Note that in the first through fourth embodiments, an example in which the present invention is applied to a caliper floating-type disc brake is described, but the present invention is not limited thereto, and may be applied similarly to any type of disc brake having a supporting member for supporting the brake pads and a return spring attached to the brake pads, such as an opposing piston type disc brake.

[0044] According to the disc brake in each of the embodiments described above, by providing positioning means, displacement and deformation of the return spring caused when a worker unintentionally touches or otherwise interferes with the return spring during installation in a vehicle, washing of the vehicle, or the like can be prevented, and thus the functions of the return spring can be maintained.